REMARKS

This responds to the Office Action dated 5 October 2005. Applicant respectfully requests reconsideration of the application in view of the foregoing amendments and following remarks. Claims 7 and 51 have been amended. Claim 7 positively recites “a shoulder bearing against a tightening fastener.” Claim 51 has been amended as suggested by the Examiner to include a semicolon but is otherwise unchanged. Claims 19-41 and 46 were previously withdrawn. Therefore, claims 1-18, 42-45, and 47-51 remain pending in the application.

<u>Allowable Claims</u>

Applicant acknowledges with appreciation the allowance of claims 1-4, 8-16, 18, 43, 47, and 48. Applicant also acknowledges that claim 51 would be allowable with the addition of a semicolon to line 6. Claim 51 has been amended as suggest and therefore should be allowable.

<u>Claim Rejections – 35 U.S.C. § 103</u>

The Examiner rejected claims 5-7, 17, 42, 44, 45, 49, and 50 under 35 U.S.C. § 103 as being unpatentable over Koepke (U.S. Pat. No. 5,015,207). Applicant acknowledges with appreciation that the rejection is non-final, affording Applicant a fair opportunity to respond.

The Examiner rejected claims 5-7, 17, 42, 44, 45, 49, and 50 under 35 U.S.C. § 103 with the admission that each claim recites subject matter that is not disclosed by Koepke or any other cited reference. The Examiner argues instead that each of the missing claim limitations is an obvious matter of design choice or would involve a mere change in component shape. Thus, the Examiner takes constructive Official Notice of the obviousness of many limitations that are lacking from the prior art. Applicant respectfully traverses the rejections.

As the Examiner knows, for a claim to be obvious, there must be a) a suggestion or motivation to combine reference teachings, b) a reasonable expectation of success, and c) the references must teach ***all of the claim limitations***. MPEP § 706.02(j).

With regard to claim 5, the Examiner contends that Koepke teaches most of the claim limitations but "lacks the mold being shaped to fit into a swage lock." However, the Examiner states that it would have been an obvious matter of design choice to change the shape of the mold to a shape that would fit into a swage lock. The Examiner does not explain why the swage lock shape would be obvious, even though nothing in the cited prior art discusses molds that could fit into swage locks. The Examiner also contends that the instant specification and evidence of record fail to attribute any significance to the particular shape claimed.

Although not expressly stated, the Examiner has taken Official Notice that insulating molds disposed over electrically conductive transmission lines that are shaped to fit in a swage lock are obvious. Nevertheless, the Examiner did not offer any support for this Official Notice. As cited above, obviousness rejections require a *prima facie* showing that the cited references teach all of the claim limitations. If, however, the references do not teach all of the limitations (as in the present case), the Examiner can take Office Notice or argue inherency. The Examiner has not argued inherency, and therefore the statements related to the obviousness of the claimed shape are supported by the Examiner's personal knowledge alone. As the Examiner knows, in the absence of any reference specifically teaching the limitation *as claimed*, Applicant can, and hereby does, respectfully request that the Examiner submit affidavits in accordance with 37 C.F.R. §1.104(d)(2) substantiating each obviousness allegation unsupported by a reference teaching. Applicant also requests opportunity to contradict each of the Examiner's affidavits as prescribed by the rule.

Moreover, although the Examiner alleged that the Applicant "fail[ed] to attribute any significance...to the particular shape," Applicant has in fact done so. Applicant contends that a mold shaped to fit into a swage lock is not simply a "change of shape" as characterized by the Examiner. The shape to fit a swage lock is not simply a different shape with no articulated advantage. The specification clearly describes advantages of the shape. The specification and figures describe how the shape of the mold can facilitate, for example, a high temperature, high pressure seal. The specification teaches the creation of a mechanical seal in paragraph 23, a seal made possible in part by the mold shape that is not disclosed by Koepke or any other cited reference. Therefore, contrary to the Examiner's suggestion, Applicant has shown and described advantages associated with the mold shape, and therefore a rejection based on "design choice" is improper and made only with the aid of impermissible hindsight. Further, in some embodiments, if the tail end of the feedthru of the present application is exposed to extreme pressures, the high pressures will serve to *enhance* the seal of the mold shaped to a tighter fit into a swage lock, while the Koepke "mold" has no structure that can mimic this advantage. Accordingly, Applicant respectfully requests that the Examiner withdraw the rejection of claim 5 under 35 U.S.C. § 103.

The same arguments offered above apply similarly to the rejection of claim 6. The Examiner admits that Koepke lacks any teaching or suggestion of a mold comprising a wedge. The "wedge" is positively recited and not disclosed by Koepke. There are also reasons for the shape articulated in the specification. Thus, the Examiner bears the burden of showing this structure in the prior art or taking Official Notice that a "wedge" is an obvious shape for insulating molds disposed over electrical feedthrus. Applicant does not agree that wedge molds are an obvious matter of design choice for electrical feedthrus, and therefore Applicant invokes

37 C.F.R. §1.104(d)(2), which requires the Examiner to withdraw the rejection or submit an affidavit substantiating the allegation. Applicant also requests opportunity to contradict the Examiner's affidavit as prescribed by the rule.

The Examiner rejected claim 7 over Koepke although Koepke does not disclose a "mold compris[ing] a shoulder." Again, Applicant notes that a *prima facie* obviousness rejection requires that the cited reference teach all of the claim limitations, and Koepke does not. Although the "shoulder" is a positively recited structural claim element, not a "mere change in shape," the Examiner contends that it would have been obvious to add a shoulder to the Koepke "mold." Applicant respectfully disagrees. Applicant points out that there has been no showing of a mold with a shoulder, and therefore the only support for a "shoulder" is the Examiner's allegation constituting personal knowledge. Therefore, in the absence of any actual reference teaching a feedthru with a mold comprising a shoulder as claimed, Applicant again respectfully requests that the Examiner submit an affidavit, subject to traverse, in accordance with 37 C.F.R. §1.104(d)(2) substantiating the allegation.

In addition, the Examiner states that Applicant has not attributed any significance to the shoulder. Applicant respectfully notes that paragraph 23 of the present specification identifies the shoulder and describes one embodiment in which the shoulder offers the advantage of a bearing surface for creating a seal with the mold.

The Examiner also read the "for bearing against a tightening fastener" out of claim 7. Although unnecessary, Applicant has amended claim 7 to positively recite the tightening fastener bearing against the shoulder as shown in the figures. For this reason and the reasons cited above, Applicant respectfully requests that the Examiner withdraw the rejection of claim 7 over Koepke.

The Examiner rejected claim 17 over Koepke and admitted that Koepke does not disclose "the core compris[ing] a rod having a first diameter and a shoulder wherein the rod comprises a second diameter larger than the first diameter." This identified claim limitation is much more than "an obvious matter of design choice" as alleged by the Examiner. This limitation describes a core with structural specificity, and it must be shown by the prior art or (if generally known in the art by the Examiner on a personal basis for the particular use) supported by an affidavit for a proper § 103 rejection. There is no "rod" disclosed by Koepke, nor are the other structural limitations shown. Thus, Applicant respectfully invokes 37 C.F.R. §1.104(d)(2) again, and awaits opportunity to contradict the Examiner's affidavit. Further, as with the other rejections addressed above, Applicant contends that the figures and specification identify several significant aspects of the "rod" and the multi-diameter core. *See, e.g.*, paragraph 27 and FIG. 3.

The Examiner rejected claims 42, 44, and 49 over Koepke, although Koepke admittedly does not teach a "disk." Claims 42, 44, and 49 specifically recite a "disk," but the Examiner states that Koepke "lacks the electrical feedthru having a disk *shape*." The Examiner states that it would have been an obvious matter of design choice to change the Koepke insulator to a disk shape. However, Applicant notes that a "disk" itself is positively recited. If Koepke does not teach or suggest a "disk," then the inquiry is over and a § 103 rejection is improper. Nevertheless, if the Examiner continues to uphold the rejection, at Applicant's request made herein, the Examiner must submit an affidavit supporting the allegation that it would be obvious to include a "disk" with the other electrical feedthru structure recited in the rejected claims. 37 C.F.R. §1.104(d)(2).

In addition, with regard to at least claim 44, the Examiner notes that although neither Koepke nor any of the other cited references teach a "disk having a gradually tapered first end,"

it would have been an obvious matter of design choice to change the shape of the feedthru to one having a gradually tapered first end. Applicant respectfully disagrees. As the Examiner admitted, none of the cited references disclose a disk with a gradually tapered first end. Therefore, the Examiner has not met his burden of establishing a *prima facie* case of obviousness. Moreover, the Examiner has not provided any motivation from the references for making a change to a gradually tapered first end. Accordingly, the § 103 rejection is improper and should be withdrawn.

Further, although the Examiner alleged that the Applicant "fail[ed] to attribute any significance...to the particular shape," Applicant has in fact done so. Applicant contends that a disk with a tapered first end is not simply a "change of shape" as characterized by the Examiner. The gradual taper is not simply a different shape with no articulated advantage. The specification clearly describes at least one advantage of the tapered shape. The specification and figures describe how the tapered shape facilitates wedged or sealed insertion between distinct environments not offered by the Koepke device. Applicant also points to FIG. 5 and paragraph 30 of the present application, which show and describe how a taper guides or facilitates insertion of a feedthru into an aperture. Accordingly, Applicant respectfully requests that the rejection of claim 44 under 35 U.S.C. § 103 over Koepke withdrawn. However, if the Examiner believes using a disk with a gradually tapered first end is obvious despite the lack of any such reference teaching, Applicant must again respectfully request that the Examiner submit an affidavit, subject to traverse, in accordance with 37 C.F.R. §1.104(d)(2) substantiating the allegation.

The Examiner rejected claim 45 over Koepke while acknowledging that Koepke "lacks the electrical feedthru having a disk shape and the mold being wedge shaped." The Examiner suggests that changing the Koepke electrical feedthru to the "disk shape and the mold to a wedge

shap[e]...would have been an obvious matter of design choice." Applicant respectfully traverses the rejection.

Similar to the discussions offered above, there is no reference disclosing either "a disk" or "a wedge-shaped insulating over-mold." Therefore, the only support for the obviousness rejection is the Examiner's personal knowledge. Applicant contends that at least the structural elements acknowledged by the Examiner to be completely missing from Koepke are not obvious matters of design choice. Therefore, in the absence of any reference disclosing the claim elements, Applicant requests an affidavit from the Examiner in accordance with 37 C.F.R. §1.104(d)(2). Applicant also raises the same arguments advanced above related to the significance of the disk and the wedge-shaped over mold.

Applicant notes that although the Examiner has pointed to column 4, lines 7-17 in support of an electrical feedthru having a variety of geometric configurations, the test for obviousness is not a reference that recites a general "variety," the claim limitations must be taught in an invalidating reference *in as complete detail as is recited in the claims*, and the Koepke does not do so. In fact Koepke does not address *any* alternative shapes at all for the "mold." At most, column 4, lines 7-17 of Koepke discuss the "feedthru lead 10." The identified portions of Koepke do not address shapes of an over-mold. Therefore, the claim rejections based on § 103 are improper and should be withdrawn.

The Examiner rejected claim 50 over Koepke, and admitted that Koepke "lacks the first end comprising a gradual taper and the second end being splined." Again, Applicant reminds the Examiner that a proper § 103 rejection requires a showing of all the claim limitations in either a prior art reference or by taking Official Notice of subject matter deemed obvious by the Examiner according to personal knowledge. The Examiner has chosen the latter by default and

admitted that several limitations of claim 50 are not taught or suggested by Koepke. Therefore, Applicant requests that the Examiner provide an affidavit in accordance with 37 C.F.R. §1.104(d)(2) substantiating the allegation that it would have been obvious to change the Koepke feedthru to include a gradual taper at the first end and a splined second end despite the lack of any such reference teaching, motivation, or suggestion.

Moreover, the Examiner again contends that the specification does not attribute any significance to the structure defining the core. First, the "gradual taper and the second end spline[d]" are not just shapes. These positive structural limitations must be considered. They are not mere changes in shape, they define the structure of the "core." Second, the specification describes the significance of the core structure. Applicant respectfully points to paragraphs 27-30, among other places in the present specification, which clearly articulate some embodiments with gradual tapers and splined ends and some of the significance attributed to the structures. The Examiner appears to have stated in every instance above that the "shapes" of the recited structures have no significance, when the specification communicates the opposite.

Applicant believes that at best, all of the claim rejections are made with the aid of impermissible hindsight. The combination (of Koepke with the Examiner's Official Notice that swage and wedge shapes, disks, tapered first ends, and splined second ends are all well known in the external trace feedthru art) must be motivated for a proper obviousness rejection. In the present case, motivation to arrive at the claim limitations is missing. The Examiner has not even alleged these swage shapes, wedge shapes, disks, tapered first ends, and splined second ends provide their own suggestion for combination with Koepke. Yet even if Koepke and the Official Notices taken did teach all of the claim limitations, then what the Office has done is a classic example of "us[ing] the claimed invention as an instruction manual or 'template' to piece

together the teaching of the prior art so that the claimed invention is rendered obvious...One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." *In re Fritch*, 23 USPQ 2d 1780 (Fed. Cir. 1992). The Examiner has not offered anything from the prior art that would motivate or even teach the claimed structures.

Therefore, Applicant respectfully requests that the Examiner withdraw the rejection of claims 5-7, 17, 42, 44, 45, 49, and 50 under 35 U.S.C. § 103 over Koepke. Further, if any of the rejections remain, Applicant must be provided with affidavits from the Examiner substantiating all allegations of obviousness relating to features that are admittedly not disclosed or suggested by the cited references. Applicant requests the opportunity to contradict the affidavits as well.

Conclusion

Applicant respectfully submits that all claims should now be in condition for allowance. Applicant respectfully requests that the Examiner telephone the undersigned attorney if there are unresolved matters in the present application so that the examination process can be expedited.

Respectfully submitted,

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United States Patent [19]

Koepke

[11] **Patent Number: 5,015,207**

[45] **Date of Patent: May 14, 1991**

[54] **MULTI-PATH FEED-THRU LEAD AND METHOD FOR FORMATION THEREOF**

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[73] Assignee: **Isotronics, Inc.**, New Bedford, Mass.

[21] Appl. No.: **458,092**

[22] Filed: **Dec. 28, 1989**

[51] **Int. Cl.**[5] **H01R 4/58**

[52] **U.S. Cl.** **439/886**; 439/78; 439/931; 439/933; 29/847; 29/885

[58] **Field of Search** 439/884, 886, 907, 931, 439/75, 78, 933; 29/874, 885, 847

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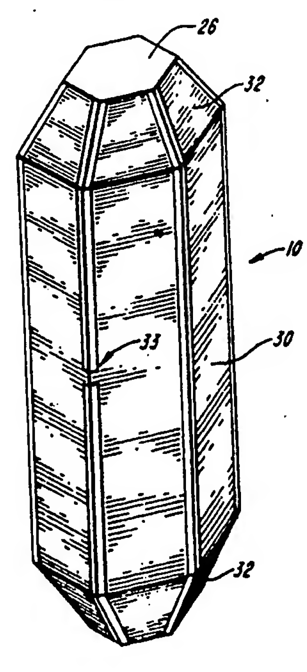
Attorney, Agent, or Firm—Weingarten, Schurgin, Gagnebin & Hayes

[57] **ABSTRACT**

A multi-path feed-thru lead is disclosed that provides increased conductive pathway density and that has particular utility in combination with microcircuit packages housing hybrid and semiconductor discrete and integrated circuit chips. The multi-path feed-thru leads have a configuration that facilitates sealing thereof in the apertures of microcircuit packages to provide increased conductive path density. The multi-path feed-thru lead according to the present invention includes an insulative substrate having a predetermined geometric configuration and includes an extended intermediate portion and first and second end portions configured to define a plurality of bonding pads that facilitate wire bonding to the circuitry housed in the package and to external circuitry, respectively. A plurality of discrete metalized conductive pathways are formed on the intermediate portion ad first and second end portions of the insulative substrate. In one preferred method of forming the multi-path feed-thru lead of the present invention, the external surface of the insulative substrate is first metalized and then selected portions of metalization are removed to form the plurality of discrete conductive pathways. The multi-path feed-thru lead of the present invention thereby provides multiple conductive pathways on a single substrate member.

17 Claims, 3 Drawing Sheets



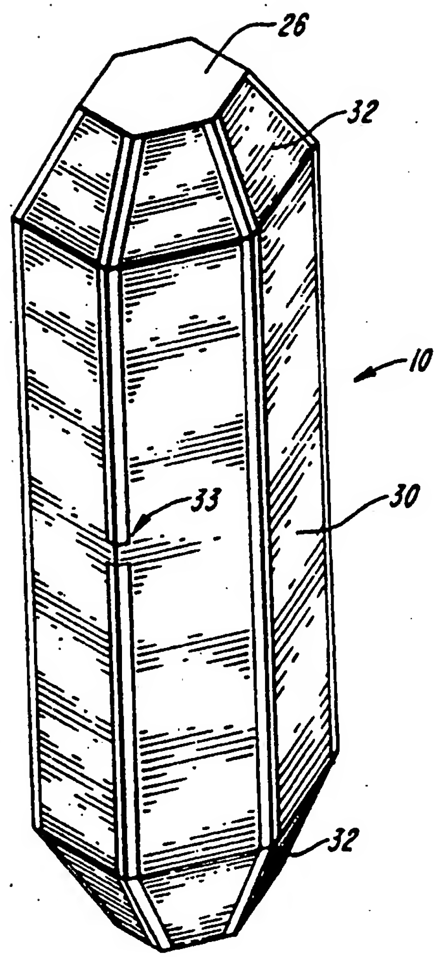


FIG. 1

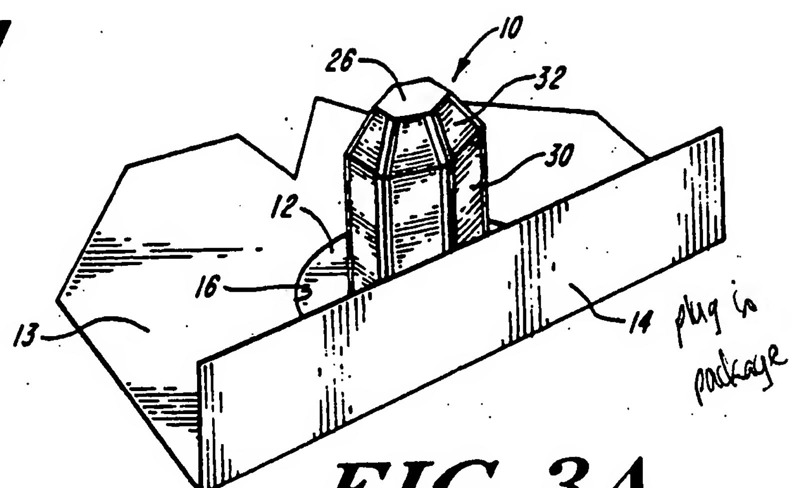


FIG. 3A

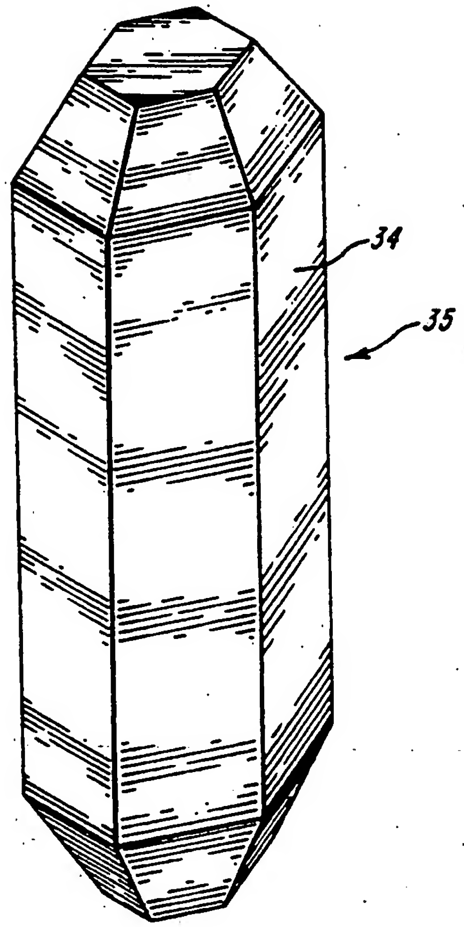


FIG. 2B

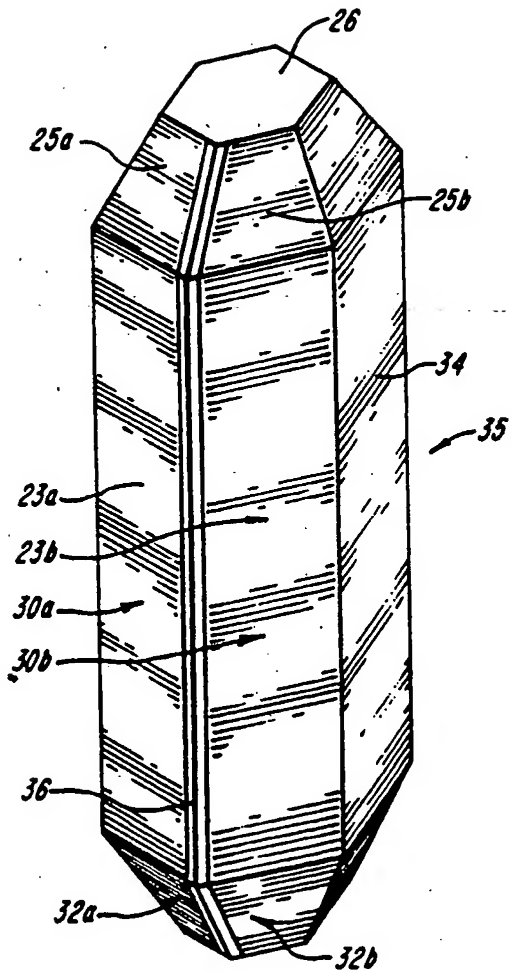


FIG. 2C

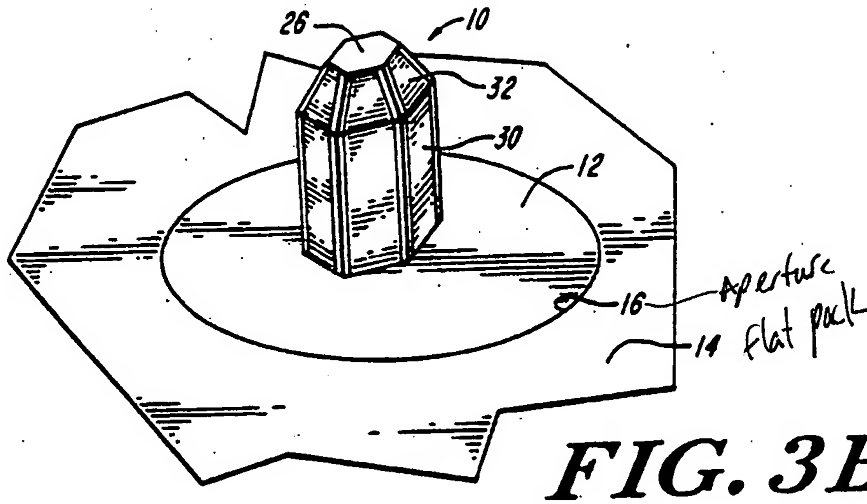


FIG. 3B

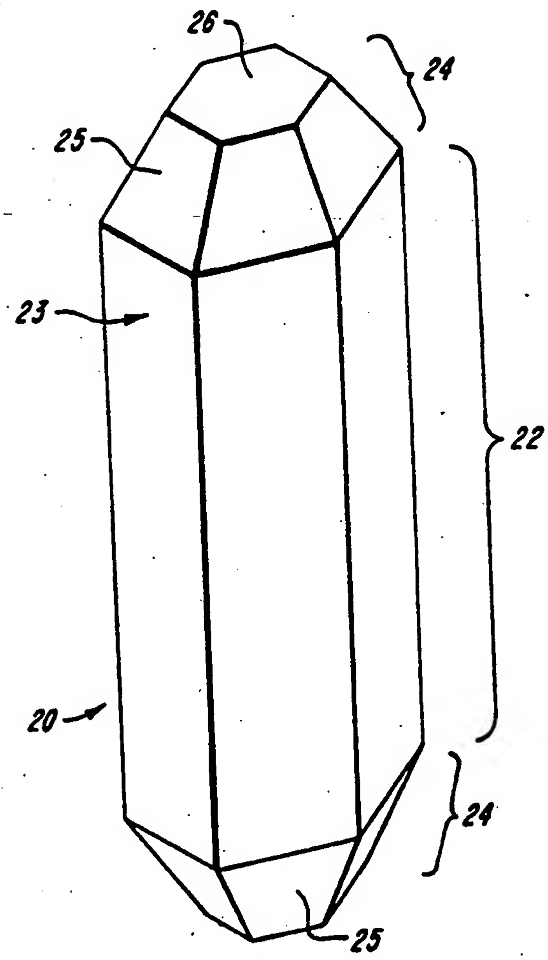


FIG. 2A

MULTI-PATH FEED-THRU LEAD AND METHOD FOR FORMATION THEREOF

FIELD OF THE INVENTION

This invention relates generally to electronic packaging leads, and more particularly to a multi-path feed-thru lead providing a plurality of discrete conductive pathways on a single substrate member.

BACKGROUND OF THE INVENTION

Microcircuit packages such as plug-in packages and flat packs have been used for many years to hermetically protect hybrid and semiconductor discrete and integrated circuit chips. The chip or chips are bottom-mounted within a metal frame, i.e., eyelet or body, of the package and electrically connected to external circuitry by means of conductive leads or pins passing through apertures in the bottom or frame. To ensure hermetic sealing and to preclude short circuiting between the leads and the metal package, the leads are sealed in insulative preforms and the insulative preform-lead combinations are sealed in the apertures of the bottom or frame.

Thus, each lead of prior art packages provided only a single conductive pathway between the integrated circuit chip mounted within the package and external circuitry. In general, the sizing of the package is dictated by the size of the ICs mounted therein. As the chip size decreases, the size of the package is decreased accordingly. Smaller package sizes, however, are generally limited as to the number of apertures that may be formed through the frame thereof, and concomitantly, the number of leads associated therewith. Forming more apertures in the frame of the metal package tends to weaken the overall structural integrity thereof since the spacing between apertures is decreased. For hermetically sealed metal packages and/or metal packages disposed in overpressurized or vacuumized environments, any decrease in the structural integrity of the metal package may lead to decreased package reliability in the operating environment.

The trend in the electronic industry is towards the utilization of very large scale integrated (VLSI) and microwave/millimeter-wave monolithic integrated circuit (MMIC) technology since such technology provides increased operational performance with smaller sized ICs. These technologies, however, require increased conductive pathway densities to accommodate increased data handling capabilities.

For many applications, such as avionics and space applications, the VLSI and MMIC components must be packaged within hermetically sealed packages. The configuration of prior art packages are generally incompatible with VLSI and MMIC technology due to the increased conductive pathway densities required. Increasing the number of conductive leads in prior art packages requires a concomitant increase in the number of apertures formed in the frame of the metal package, which generally requires an increase in overall package size and weight. The number of holes which may be formed in the body, however, is generally constrained by size, weight and structural considerations as discussed hereinabove.

One solution to the above-described problem is to utilize smaller diameter conductive leads which would permit a limited increase in conductive pathway density. Smaller conductive leads, however, are more fragile and subject to catastrophic failure during fabrication, handling, installation and/or operation in dynamic environments that are typically encountered in aerospace operations. In addition, smaller conductive leads require smaller apertures, and smaller apertures are more difficult to produce with consistent results. Moreover, smaller leads and smaller apertures require smaller insulative preforms to form the glass-to-metal seals. These smaller elements are difficult to handle and fabricate, thereby increasing the overall cost of the finished package.

SUMMARY OF THE INVENTION

The present invention surmounts the inherent disadvantages of prior art flat packs by providing a multi-path feed-thru lead that efficiently and economically permits an increase in the conductive pathway density without a significant increase in the overall size of the lead member. The multi-path feed-thru lead of the present invention has particular utility in combination with microcircuit packages to increase the conductive pathway density thereof without any significant decrease in the structural integrity thereof and/or increase in the size and weight thereof.

The multi-path feed-thru lead of the present invention has a predetermined geometric configuration that includes an extended intermediate portion and first and second end portions. The first and second end portions are configured to function as bonding pads that facilitate wire bonding to integrated circuit chips housed in the package and to external circuitry, respectively.

The multi-path feed-thru lead comprises an insulative substrate formed in the predetermined configuration and having a plurality of discrete metalized conductive paths formed on the intermediate and first and second end portions. The insulative substrate may be formed from an insulative material such as alumina, Al_2O_3 and may be a mechanically rigid structure or mechanically flexible structure, i.e., fibers. The plurality of discrete metalized conductive pathways may be formed as layers or coatings overlying the surfaces of the insulative substrate or the metalized conductive pathways may be partially diffused into the corresponding surfaces of the insulative substrate.

In one preferred method of forming the multi-path feed-thru lead of the present invention, an insulative substrate having the predetermined geometric configuration is formed. The external surfaces of the insulative substrate are then metalized to form a metalized substrate. Selected areas of metalization are then removed from the metalized substrate by conventional means such as a stripping die to form the plurality of discrete metalized conductive pathways on the intermediate portion and the first and second end portions. Strips of exposed insulative substrate separate and define adjacent metalized conductive pathways.

Each multi-path feed-thru lead according to the present invention thus provides a plurality of independent metalized conductive pathways on a single substrate member, thereby providing increased conductive pathway density for any given application. One or more of the metalized pathways may be grounded, depending upon the particular application. Conductive pathways of a multi-path feed-thru lead may be electrically interconnected by means of conductive interconnect traces to increase transmission capabilities.

The number of apertures required to be formed in the frame of the flat pack can be minimized by utilizing multi-path feed-thru leads according to the present invention. Alternatively, a significant increase in conductive pathway density may be achieved for a given package size.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the present invention and the attendant advantages and features thereof will be more readily appreciated as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a perspective view of an exemplary embodiment of a multi-path feed-thru lead according to the present invention;

FIG. 2A is a perspective view of the multi-sided insulative substrate of the embodiment of FIG. 1;

FIG. 2B is a perspective view of the insulative substrate of FIG. 2A having a metalized layer formed thereon and prior to formation of the plurality of metalized conductive pathways;

FIG. 2C is a perspective view of the metalized substrate of FIG. 2B with selected areas of metalization removed;

FIG. 3A is a partial perspective view of the multi-path feed-thru lead of FIG. 1 as utilized in combination with a plug-in package; and

FIG. 3B is a partial perspective view of the multi-path feed-thru lead of FIG. 1 as utilized in combination with a flat pack.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings wherein like reference numerals designates similar or corresponding elements throughout the several views, FIGS. 1 and 2A–2C illustrate an exemplary embodiment of a multi-path feed-thru lead 10 according to the present invention that has particular utility in combination with microcircuit packages housing hybrid and semiconductor discrete and integrated circuit chips. The multi-path feed-thru lead 10 includes an extended intermediate portion 22 and first and second end portions 24 integral with the intermediate portion 22. Extended as used herein defines a length of the intermediate portion 22 sufficient to pass through the package bottom or frame and to position the first and second end portions 24 for wire bonding to the circuitry housed in the package and external circuitry, respectively.

The multi-path feed-thru lead 10 of the present invention may be a mechanically rigid structure or a flexible structure, i.e., fiber, depending upon the particular application. As exemplarily illustrated in the drawings, the extended intermediate portion 22 is straight. It is to be understood, however, that the present invention is not to be limited by the exemplary drawings, but only by the scope of the claims. The first and second end portions 24 of the multi-path feed-thru lead 10 according to the present invention are configured to function as bonding pads that facilitate wire bonding to integrated circuit chips housed in the package and to external circuitry, respectively.

wire bonding pads to separate chips - not bonded to chips themselves

The exemplary multi-path feed-thru lead 10 illustrated in FIG. 1 has a hexagonal configuration such that the intermediate portion 22 thereof has six planar sides 23. The first and second end portions 24 are configured as hexagonal frustums, each end portion 24 having six corresponding tapered planar sides 25 terminating in an end face 26. For the embodiment of FIG. 1, the tapered planar sides 25 of the first and second end portions 24 define the bonding pads of the multi-path feed-thru lead 10.

It is to be understood that the Particular geometric shape of the illustrated multi-path feed-thru lead 10 is for purposes of explanation only. The multi-path feed-thru lead may be formed to have intermediate and end portions having a variety of geometric, configurations. The particular configuration will depend, inter alia, upon the number of conductive pathways, i.e., the conductive pathway density, required for the particular application, the size and shape of the frame of the package, and the outer dimensions of the multi-path feed-thru lead and the insulative preforms utilized therewith.

To form the exemplary multi-path feed-thru lead 10 according to the present invention, an insulative substrate 20 is formed to have a predetermined geometric configuration including an intermediate portion 22 and first and second end portions 24. The insulative substrate 20 may be formed from a number of insulative materials. The insulative material, when formed into the particular geometric configuration of the substrate, should have structural integrity, e.g., rigid, flexible, consonant with the particular application environment in which the package is intended to operate. The insulative material should also have a coefficient of thermal expansion that is compatible with the insulative preforms and metallic materials utilized in fabricating the package. Disclosure regarding coefficients of thermal expansion, and exemplary preforms having utility in the formation of glass-to-metal seals, is presented in U.S. Pat. Nos. 4,716,082 and 4,788,382, which are hereby incorporated by reference. Ceramics such as alumina, Al_2O_3, may be utilized as the insulative material to form the insulative substrate of the present invention.

Discrete pathways of conductive metal 30, 32 are formed on each of the corresponding sides 23, 25 of the extended intermediate portion 22 and the firs and second end portions 24, respectively, of the multi-sided insulative substrate 20. The portions of the metalized conductive pathways 32 formed on the sides 25 of the first and second end portions 24 function as metalized bonding pads that are integrally coupled with the metalized conductive pathways 30 formed on the extended intermediate portion 22. The metalized bonding pads 32 provide the means for wire bonding the integrated circuit chips (not shown) housed within the flat pack and the external circuitry (not shown), respectively.

again, chips housed in flat pack, not mounted to the core the pads are metal

Adjacent metalized, conductive pathways 30 may be electrically interconnected by means of one or more conductive interconnect traces 33. The conductive interconnect traces 33 are formed on the insulative substrate 20 in the manner as described in further detail hereinbelow.

The metalized conductive pathways 30, 32 and conductive interconnect traces 33 may be formed as layers or coatings overlying the surfaces of the sides 23, 25 of the insulative substrate 20. Alternatively, the metalized conductive pathways 30, 32 may be partially diffused into the corresponding surfaces of the insulative substrate 20. The discrete metalized conductive pathways 30, 32 and conductive interconnect traces 33 may be formed on the insulative substrate 20 by one of the several known metalization techniques. One preferred method of forming the discrete metalized conductive

pathways is described hereinbelow, but it will be appreciated that other known techniques may have applicability in forming the metalized conductive pathways.

After the insulative substrate 20 having a predetermined geometrical configuration has been formed, the entire surface thereof is metalized with a conductive metal 34 as shown in FIG. 2B to form a metalized substrate 35. As noted hereinabove, the metalized layer 34 may be formed as a coating or layer superposed on the external surfaces of the insulated substrate 20. Alternatively, a portion of the metalized layer 34 may be diffused into the surfaces of the insulative substrate 20.

The metalized substrate 35 is then further processed, for example by means of a stripping die (not shown), to selectively remove portions of the metalized layer 34 from the metalized insulative substrate 35. A partially stripped metalized insulative substrate 35 is illustrated in FIG. 2C.

Not flush not good enough to hold pressure after stripping

As illustrated in FIG. 2C, a single strip 36 of metalized layer has been selectively removed from the metalized substrate 35 along the edge between adjacent sides 23*a*, 23*b* of the extended intermediate portion 22 and the sides 25*a*, 25*b* of the first and second end portions 24. The strip 36 exposes the underlying insulative substrate to provide electrical isolation between the adjacent, partially formed discrete metalized conductive pathways 30*a*, 30*b*, 32*a*, 32*b*. Further selective removal of metalized layers along the edges between adjacent sides of the metalized substrate 35 results in the formation of a plurality (six for the hexagonal configuration illustrated) of discrete conductive pathways 30, 32. For the the multi-path feed-thru lead 10 illustrated in FIG. 1, the discrete conductive pathways 30, 32 are formed on respective sides 23, 25, and centered with respect thereto. The metalized layer 34 is also selectively removed from the end faces 26 of the first and second end portions 24, as exemplarily illustrated in FIG. 2C.

Referring to FIG. 1, the multi-path feed-thru lead 10 has six discrete metalized conductive pathways 30, 32, each metalized conductive pathway 30, 32 being defined by respective exposed strips 36 of insulative substrate. As exemplarily illustrated, one pair of adjacent metalized conductive pathways 30 are electrically interconnected by means of a conductive interconnecting trace 33. Thus, the multi-path feed-thru lead of the present invention comprises a single substrate member that provides a plurality of conductive pathways, some of which may be electrically interconnected. It will be appreciated that the multi-path feed-thru lead of the present invention may provide more or less conductive pathways depending upon the configuration of the underlying insulative substrate and the manner of selectively removing metalized portions from the metalized insulative substrate.

The multi-path feed-thru lead 10 of the present invention has particular utility in combination with microcircuit packages housing hybrid and semiconductor discrete and integrated circuit chips. The use of a multi-path feed-thru lead 10 according to the present invention in combination with a hermetically sealed package is exemplarily illustrated in FIGS. 3A, 3B. The multi-path feed-thru lead 10 may be disposed within an aperture 16 formed in the bottom member 13 of a plug-in package (FIG. 3A) or in the aperture 16 of the frame or body 14 of a flat pack (FIG. 3B) by means of a insulative preform 12 such as the type disclosed in U.S. Pat. Nos. 4,716,082 and 4,788,382. A glass-to-metal seal is formed between the insulative preform 12 and the metal package 14 at the aperture 16 to provide a hermetically sealed package.

Not itself capable of hermetic seal

Chips in plug in package or flat pack, not on Feedthru 10

In prior art packages, each aperture formed in the bottom or frame has sealed therein a single conductive lead that provided a single conductive pathway between the integrated circuitry housed within the package and external circuitry. Each multi-path feed-thru lead of the present invention, in contrast, provides a plurality of conductive pathways for each aperture. Thus, the multi-path feed-thru lead of the present invention in combination with a given package configuration provides a manifold increase in conductive pathway density. The performance characteristics of the multi-path feed-thru lead according to the present invention may be readily modified by material selection, geometric configuration, and/or metalization pattern for different applications.

The multi-path feed-thru lead according to the present invention has been described hereinabove in terms of its utility in combination with packages. It is to be understood that the multi-path feed-thru lead according to the present invention may have other applications, and therefore, the present disclosure is not intended to limit the scope of the multi-path feed-thru lead to use in combination with microcircuit packages.

Numerous modifications and variation of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the present invention may be practiced otherwise than as specifically described hereinabove.

What is claimed is:

1. A multi-path feed-thru lead providing increased conductive pathway density, comprising:

an insulative substrate having a predetermined configuration, said insulative substrate including an extended intermediate portion and first and second end portions, said first and second end portions having configurations defining a first and second plurality of bonding pads, respectively;

a plurality of metalized conductive pathways formed on said intermediate portion and said plurality of bonding pads defined by said first and second end portions, respectively, of said insulative substrate;

adjacent ones of said metalized conductive pathways being defined and separated by exposed strips of said insulative substrate; and

conductive interconnect trace means formed in said exposed strips of said insulative substrate for electrically interconnecting at least one adjacent pair of said metalized conductive pathways.

2. A method of forming the multi-path feed-thru lead of claim 1 wherein:

said plurality of metalized conductive pathways and said conductive interconnect trace means are formed by selectively metalizing said extended intermediate portion and said first and second plurality of bonding pads of said first and second end portions, respectively, of said insulative substrate.

3. A method of forming the multi-path feed-thru lead of claim 1 wherein said plurality of metalized conductive pathways and said conductive interconnect trace means are selectively formed by:

metalizing the exterior surface of said insulative substrate; and

selectively removing portions of said metalized exterior surface from said extended intermediate portion and said first and second plurality of bonding

Bond pad is to attach wire bonds - not chips

pads of said first and second end portions, respectively, of said insulative substrate to form said exposed strips defining and separating said plurality of metalized conductive pathways and to form said conductive interconnect trace means for electrically interconnecting at least one adjacent pair of said metalized conductive pathways.

4. The multi-path feed-thru lead of claim 1, wherein: said insulative substrate has a predetermined coefficient of thermal expansion compatible with an insulative preform used in microelectronic circuit packaging for providing hermetic sealing therein.

5. The multi-path feed-thru lead of claim 4, wherein: said insulative substrate is fabricated from a ceramic material.

6. The multi-path feed-thru of claim 5, wherein said ceramic material is alumina.

7. A multi-path feed-thru lead providing increased conductive pathway density, comprising:

an insulative substrate having a predetermined configuration including an extended intermediate portion and first and second end portions, said first and second ned portions having configurations defining a first and second plurality of bonding pads, respectively;

said extended intermediate portion having a plurality of planar sides arranged to define a polygonal cross-sectional configuration for said extended intermediate portion;

each of said first and second end portions having a plurality of inwardly tapered planar sides terminating in an end face and arranged to define a polygonal frustum cross-sectional configuration, said inwardly tapered planar sides defining said defining said plurality of bonding pads;

each of said planar sides of said intermediate portion being contiguous with respective ones of said plurality of bonding pads of said first and second end portions; and

a plurality of metalized conductive pathways formed on said intermediate portion and said first and second end portions, respectively;

adjacent ones of said metalized pathways being defined and separated by exposed strips of said insulative substrate.

8. The multi-path feed-thru lead of claim 7 wherein said plurality of metalized conductive pathways are formed on said planar sides of said intermediate portion and said inwardly tapered planar sides of said first and second end portions defining said plurality of bonding pads, and further wherein each said exposed strip of insulative substrate defining and separating said metalized conductive pathways includes edge portions between adjacent said planar sides of said intermediate portion and edge portions between adjacent said tapered planar sides of said first and second end portions, respectively.

9. A method for forming a multi-path feed-thru lead, comprising:

forming an insulative substrate having a predetermined configuration including an extended intermediate portion and first and second end portions having configurations defining a first and second plurality of bonding pads, respectively;

forming a plurality of metalized conductive pathways on said intermediate portion and said first and second plurality of bonding pads of said first and second end portions, respectively, of said insulative substrate, adjacent ones of said metalized conductive pathways being defined and separated by respective exposed strips of said insulative substrate; and

forming at least one conductive metalized interconnecting trace between adjacent said metalized conductive pathways for electrical interconnection therebetween.

10. A method for forming a multi-path feed-thru lead, comprising:

forming an insulative substrate having a predetermined configuration including an extended intermediate portion and first and second end portions having configurations defining a first and second plurality of bonding pads, respectively;

selectively metalizing said extended intermediate portion and said first and second plurality of bonding pads of said first and second end portions, respectively, of said insulative substrate to form a plurality of metalized conductive pathways, adjacent ones of said metalized conductive pathways being defined and separated by respective exposed strips of said insulative substrate; and

selectively metalizing said extended intermediate portion of said insulative substrate to form at least one conductive metalized interconnecting trace between said adjacent metalized conductive pathways for electrical interconnection therebetween.

11. The method of claim 9 wherein said selective metalizing step further comprises the steps of:

metalizing said insulative substrate to form a metalized insulative substrate; and

selectively stripping metalization from said metalized insulative substrate to form said respectively exposed strips of said insulative substrate, said respective exposed strips of said insulative substrate defining and separating adjacent ones of said metalized conductive pathways of said insulative substrate.

12. A method for forming a multi-path feed-thru lead, comprising:

forming an insulative substrate having a predetermined configuration including an extended intermediate portion and first and second end portions having configurations defining a first and second plurality of bonding pads, respectively;

metalizing said insulative substrate to form a metalized insulative substrate; and

selectively stripping metalization from said metalized insulative substrate to form respective exposed strips of said insulative substrate defining and separating adjacent metalized conductive pathways of said metalized insulative substrate wherein said selective metalizing stripping step further includes:

selectively stripping metalization from said metalized insulative substrate to form at least one conductive interconnect trace between an adjacent pair of said metalized conductive pathways to provide electrical interconnection therebetween.

13. A multi-path feed-thru lead providing increased conductive pathway density, comprising:

an insulative substrate having a predetermined configuration including an extended intermediate portion and first and second end portions, said first and second end portions having configurations defining a first and second plurality of bonding pads, respectively;

said extended intermediate portion having a plurality of planar sides arranged to define a polygonal

cross-sectional configuration for said extended intermediate portion;

each of said first and second portions including a plurality of inwardly tapered planar sides terminating in an end face, said inwardly tapered planar sides defining said plurality of bonding pads;

each of said planar sides of said intermediate portion being contiguous with respective ones of said plurality of bonding pads of said first and second end portions; and

a plurality of metalized conductive pathways formed on said intermediate portion and said plurality of bonding pads defined by said first and second end portions, respectively, of said insulative substrate;

adjacent ones of said metalized conductive pathways being defined and separated by exposed strips of said insulative substrate.

14. A method for forming a multi-path feed-thru lead, comprising:

forming an insulative substrate having a predetermined configuration including an extended intermediate portion and first and second end portions having configurations defining a first and second plurality of bonding pads, respectively;

said extended intermediate portion having a plurality of planar sides arranged to define a polygonal cross-sectional configuration for said extended intermediate portion;

each of said first and second end portions including a plurality of inwardly tapered planar sides terminating in an end face, said inwardly tapered planar sides defining said plurality of bonding pads;

each of said planar sides of said intermediate portion being contiguous with respective ones of said plurality of bonding pads of said first and second end portions; and

forming a plurality of metalized conductive pathways on said intermediate portion and said first and second plurality of bonding pads of said first and second end portions, respectively, of said insulative substrate, adjacent ones of said metalized conductive pathways being defined and separated by respective exposed strips of said insulative substrate.

15. The method of claim 14, further comprising:

forming at least one conductive metalized interconnecting trace between adjacent said metalized conductive pathways for electrical interconnection therebetween.

16. The method of claim 14, wherein:

said inwardly tapered planar sides defining said bonding pads are arranged to define a polygonal frustum cross-sectional configuration.

17. The method of claim 16, further comprising:

forming at least one conductive metalized interconnecting trace between adjacent said metalized conductive pathways for electrical interconnection therebetween.

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